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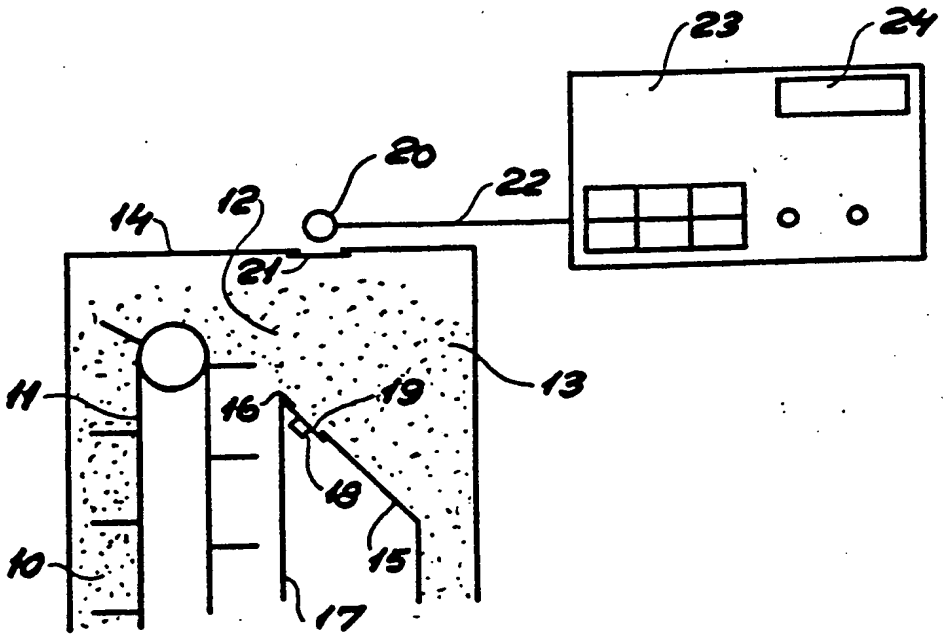

(57) Abstract

For continuous measurement of the mass flow of threshed grain in a combine harvester by means of a signal transmitter (18) and a signal detector (20) placed on their respective sides of a passage (12) for the grain flow, use is made of a beta, gamma or X-ray radiation source as a signal transmitter. Since the attenuating effect of the grain flow on these rays practically does not depend upon other variable factors than the density of the grain flow, the output signal of the detector is an accurate expression of this density. Knowing the velocity of the grain flow and the cross sectional area of the passage, the mass flow can then be calculated with a correspondingly great accuracy.

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" Measuring the flow of grain in a combine harvester."

To measure mass flow of threshed grain in a combine harvester it is known to use light or sound beams transmitted from a light source or sound generator through the grain flow in a passage in the combine harvester and thus attenuated by the grains to a degree which is dependent upon the mass flow and is thus a measure of this flow. Where the grain flow passes at a velocity V through a passage of the cross sectional area A and the density of the grain in the passage is assumed to be ρ, the mass flow will be

$$F = \rho \cdot A \cdot V$$

However, it has been found that attenuation of light or sound beams in practice is not a reasonably accurate expression of the mass flow because the attenuation also depends upon other factors, such as the structure, humidity, etc. of the material. The inaccuracy in the measurement of the density ρ reoccurs in the determination of the mass flow F.

It is known from other fields of the art to use other types of radiation, e.g. beta rays, gamma rays or X-rays, to measure mass flow, e.g. of a granular material moving on a conveyor belt or dropping down through a shaft.

The object of the invention is to improve the accuracy in the measurement of the grain flow in a combine harvester, and as stated in claim 1 the invention relies on substituting beta rays, gamma rays or X-rays to perform this measurement for sound waves or light beams,

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because it has been found that the attenuation or the change of such rays virtually does not depend upon other variable factors than the density of the grain flow.

A particularly expedient radiation source in practice is a piece of americium 241.

An apparatus for realizing the use according to the invention is shown in the schematic drawing as mounted adjacent to a measuring passage connected to the top portion of a grain elevator and will be described more fully below with reference to the drawing.

In the drawing,the numeral 10 designates a shaft in which a grain elevator 11 consisting of a chain conveyor with buckets is mounted. At the upper end of the elevator the grain is thrown out through a passage 12 to an intermediate chamber 13, from which it drops down into a grain tank (not shown). The shaft 10 and the chamber 13 are defined by steel plates forming i.a. a horizontal top wall 14 and a side wall 15, which extends obliquely downwards from the top edge 16 of one shaft wall 17. In the angle between the two walls 15 and 17 and close to the vertex there is mounted a gamma radiation source 18 in the form of a piece of americium 241 with an intensity of about 1 mCi, and adjacent to this radiation source a section of the plate wall 15 is replaced by an aluminium plate 19 which attenuates the gamma rays less than the steel plate. Opposite the radiation source 19 and directly above the top wall 14 there is placed a gamma ray detector 20, which preferably consists of a sodium iodide scintillator with an associated photo multiplier. An aluminium window 21 is inserted in the top wall 14 adjacent to this detector. The detector 20

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is connected to a computing unit 23, which has i.a. an indicator 24, by a line 22.

The velocity at which the grain flows through the passage 12 is proportional to the operating velocity of the grain elevator 11, and is thus a constant k multiplied by the rotational velocity of one of the rollers over which the elevator belt runs. The attenuation of the gamma rays from the source 18, measured by the detector 20 and produced by the grain flow, is a function of the density ρ of the grain flow between the source and the detector, and on the basis of these quantities and the cross sectional area A of the passage 12 the mass flow will be

$$F = k \cdot V \cdot A \cdot \rho \text{ (kg/sec.)},$$

and this quantity is continuously indicated by the indicator 24 of the computing unit. The computing unit may also be designed for automatic zero point adjustment and to display various relevant quantities, such as e.g. capacity in barrels/hour, total amount of crop, yield in proportion to seed sown, etc.

Instead of the rays from the radiation source impinging on the detector directly after having been attenuated by the grain flow, the detector may be shielded against direct irradiation so that it just receives rays refracted by the grain flow, the scattering of the rays thus provided, like the transmission attenuation being an unambiguous measure of the density. Other types of radiation sources than americium 241, e.g. X-ray tubes, and other forms of detectors than scintillation oscilloscopes, e.g. Geiger tubes, ionization chambers and semi-conductors, may be used. Moreover, both the radiation source and the

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detector may be placed in another manner in a combine harvester than shown in the drawing and described in the foregoing, just as several radiation sources and/or detectors may be used for the determination of density.

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Patent Claims:

1. Use of measurement of attenuation or another change of beta rays, gamma rays or X-rays transmitted through or refracted by a flow of material for continuous measuring of the mass flow of threshed grain which passes through a passage in a combine harvester.

2. Use according to claim 1 of a piece of americium 241 as a radiation source.

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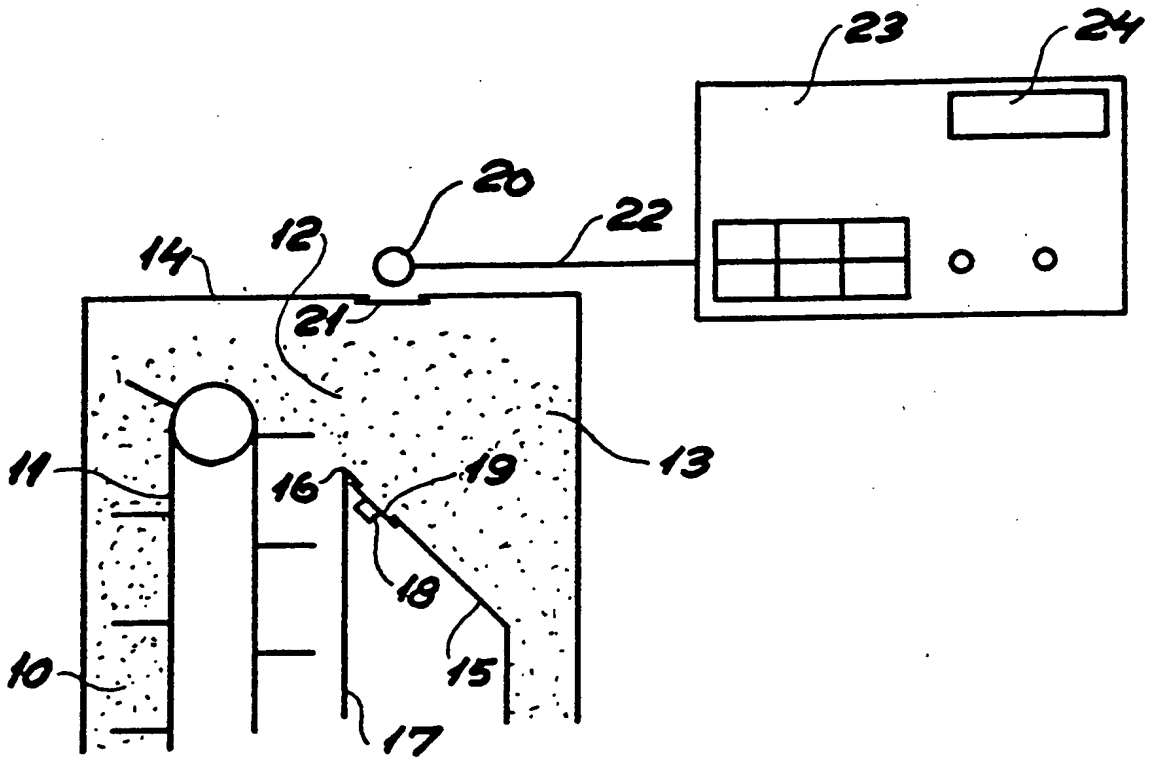

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